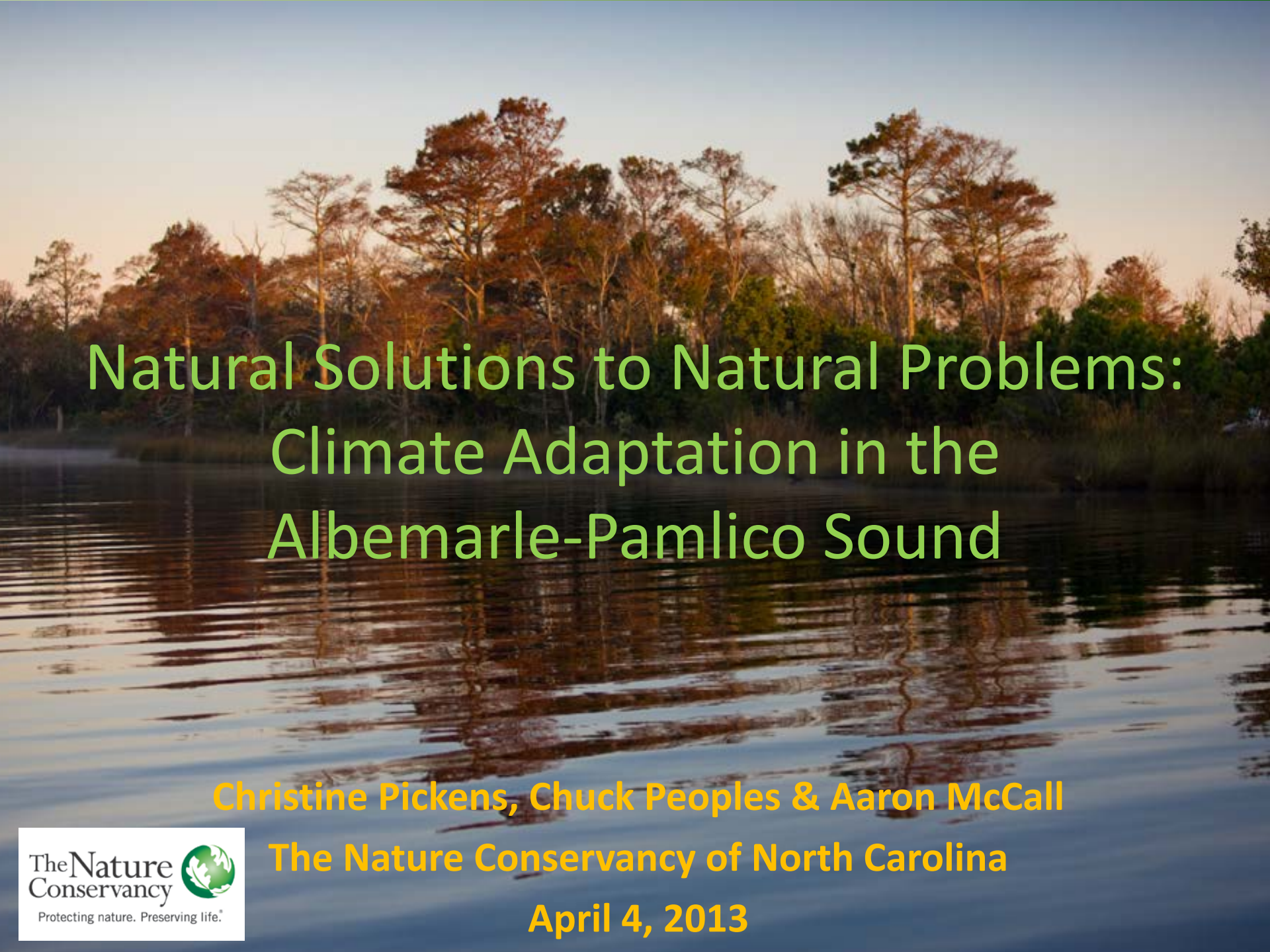


Natural Solutions to Natural Problems: Climate Adaptation in the Albemarle-Pamlico Sound

Christine Pickens, Chuck Peoples & Aaron McCall

The Nature Conservancy of North Carolina

April 4, 2013

The Nature Conservancy
Protecting nature. Preserving life.®

Atlantic Ocean

Albemarle Sound

Albemarle-Pamlico Peninsula

Pamlico Sound

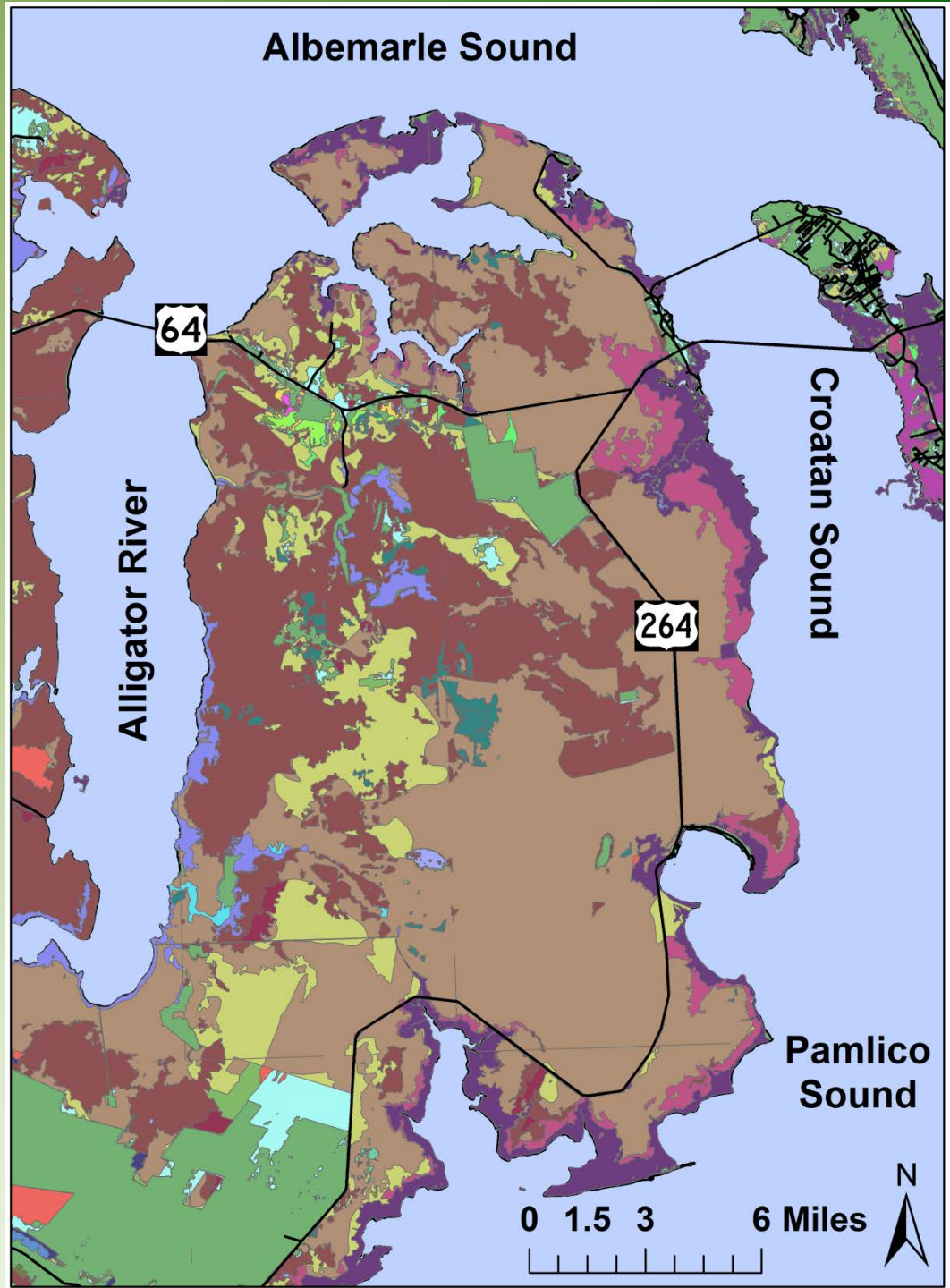
Image: Google Earth

The Nature Conservancy

Protecting nature. Preserving life.®

Peatland Ecosystem Mosaic

- Pocosin
- Swamp forest
- Pine flat
- Hardwood flat
- Riverine swamp forest
- Estuarine shrub/scrub
- Fresh marsh
- Brackish marsh



The Nature Conservancy
Protecting nature. Preserving life.®

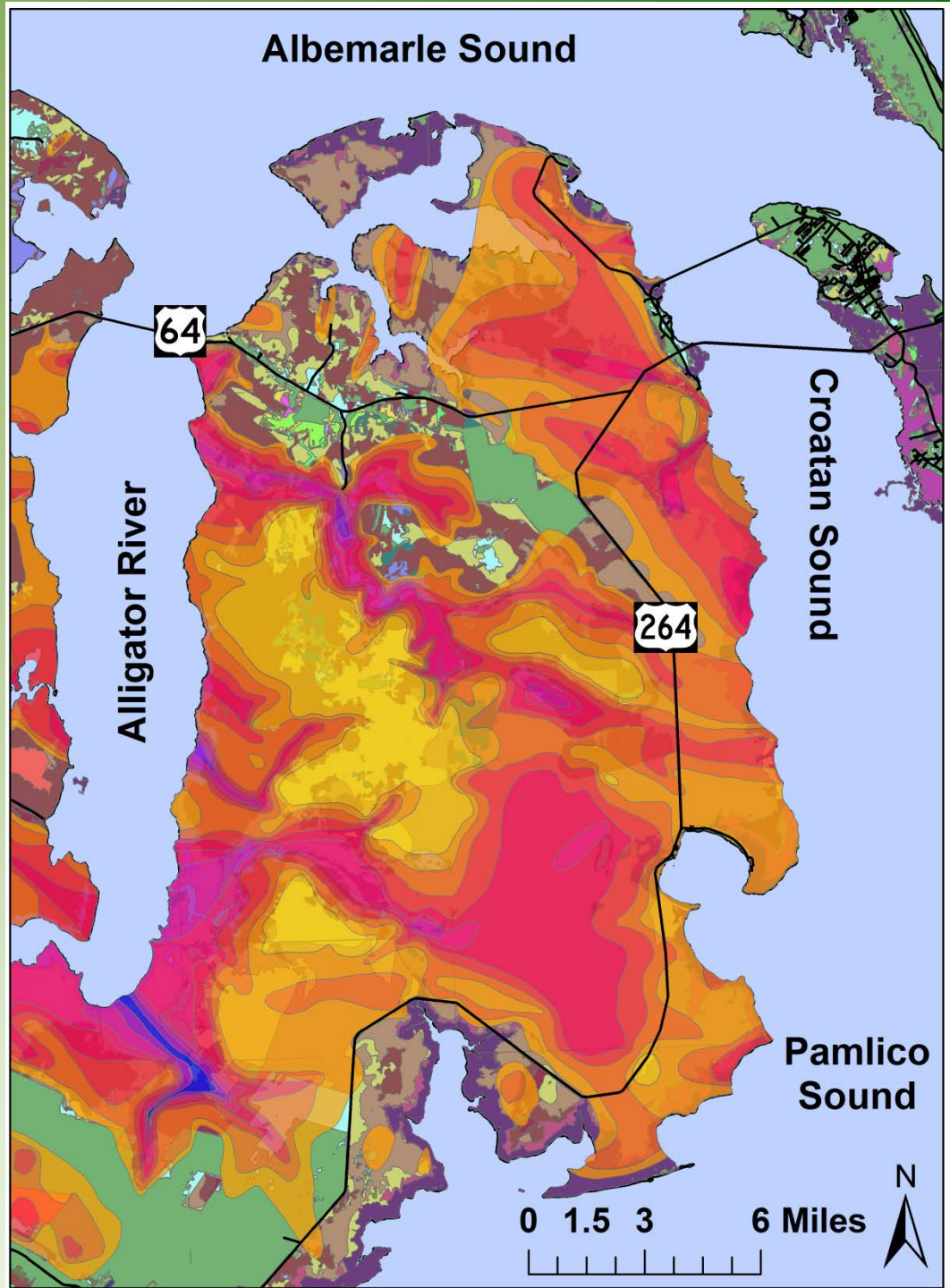
Peatland Ecosystem Mosaic

- Pocosin
- Swamp forest
- Pine flat
- Hardwood flat
- Riverine swamp forest
- Estuarine shrub/scrub
- Fresh marsh
- Brackish marsh

Peat Depth (ft)

0 7 14

The Nature Conservancy
Protecting nature. Preserving life.®

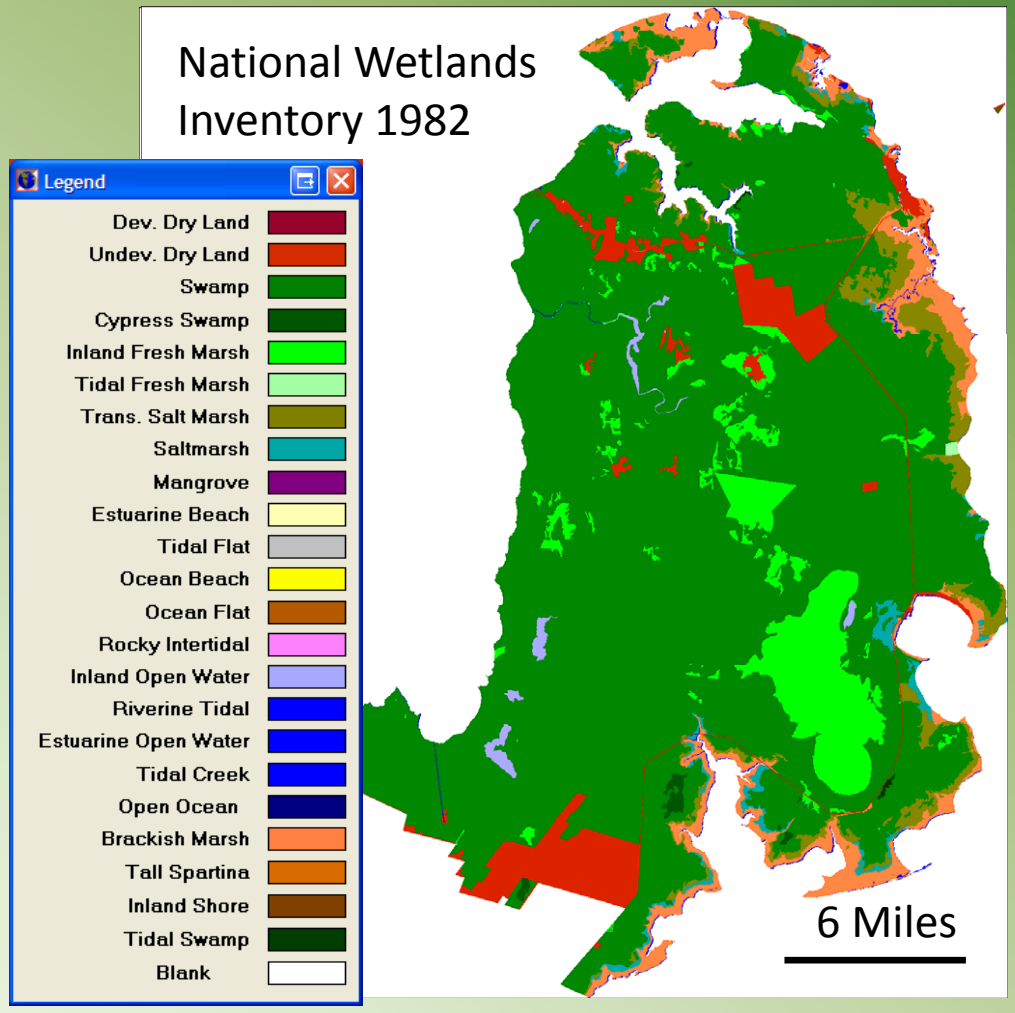


Natural Problems

Climate Change Factors

- Sea-level rise
  - Habitat conversion
  - More open water
- Salt water intrusion
  - Habitat conversion
  - Stimulated peat decomposition
- Increased severity and frequency of storms
  - Erosion
  - Salt water intrusion

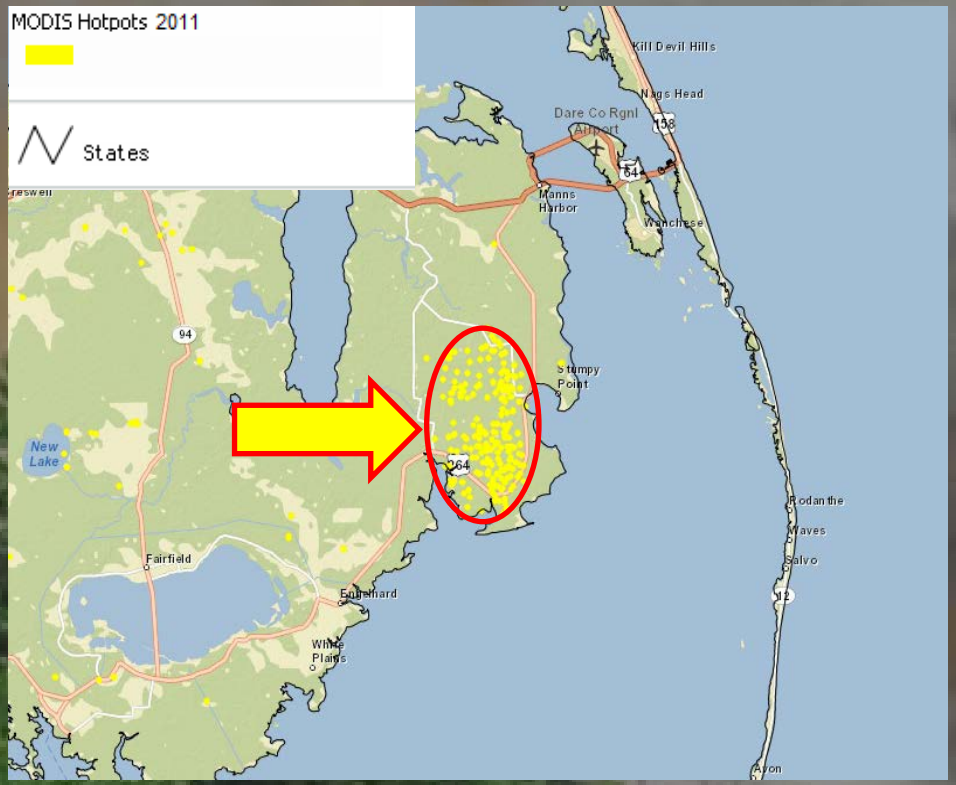
SLAMM Model (5) for Alligator River NWR
1 m eustatic sea-level rise by 2100



The Nature Conservancy
Protecting nature. Preserving life.®

More Natural Problems

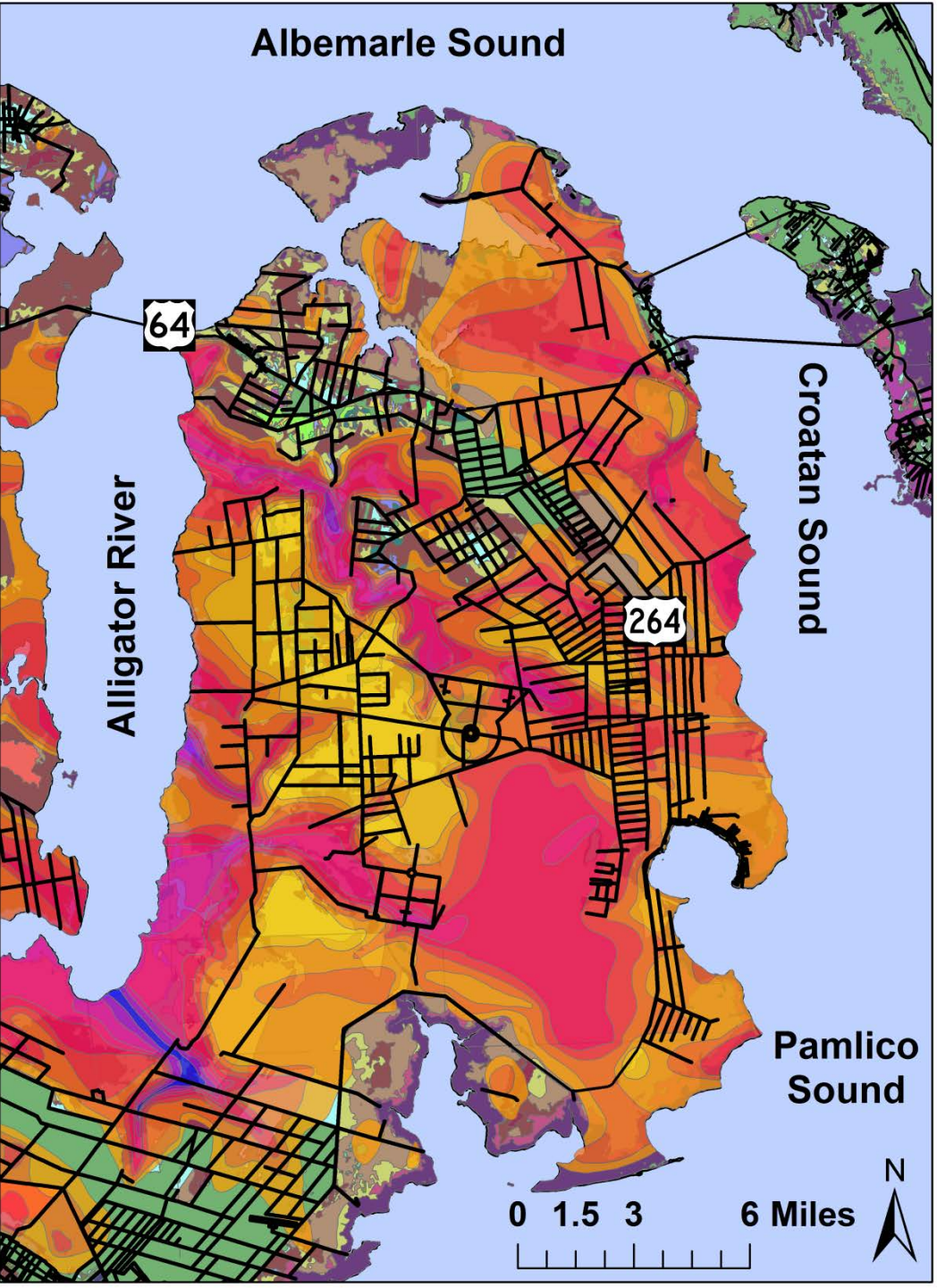
USDA Forest Service FORWARN Model



Catastrophic Wildfires

- Pains Bay Fire (2011)
  - 45,294 acres
  - Lasted 120 days
  - Cost $14,000,000
  - **5,529,088** tons of carbon lost to the atmosphere (Mickler)
- Similar-sized fires at Pocosin Lakes NWR and Great Dismal Swamp NWR

Rob Schakelford, NCFS



Not-So-Natural Problems

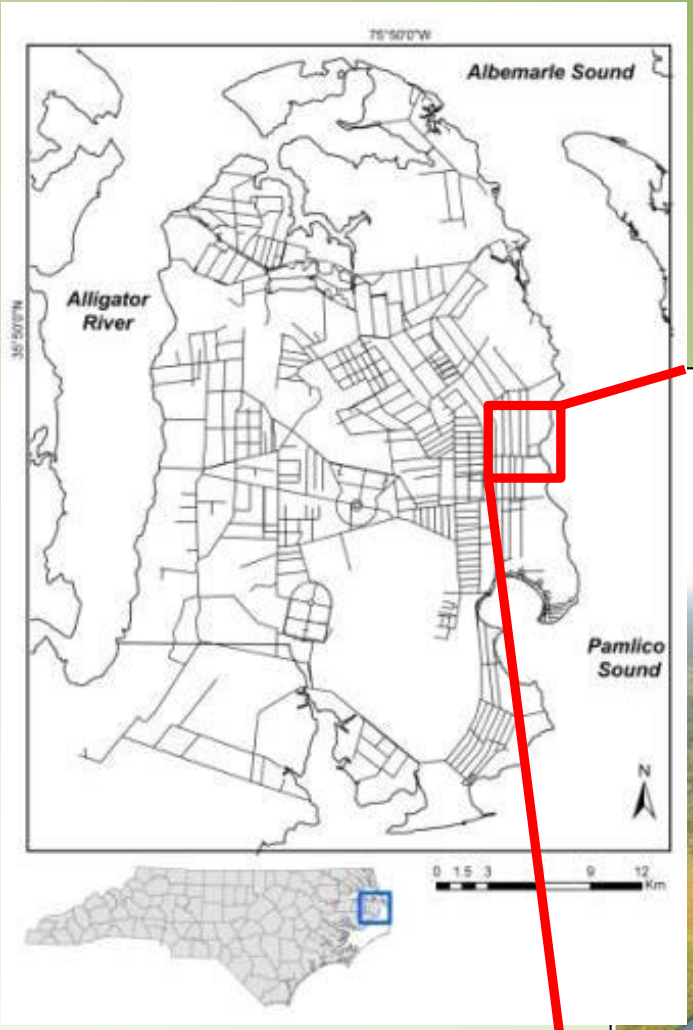
- Ditches
  - Lowered water table
  - Peat oxidation
  - Subsidence
  - Salt water intrusion points
- Roads
  - Reduction of connectivity
  - Unintentional impounding

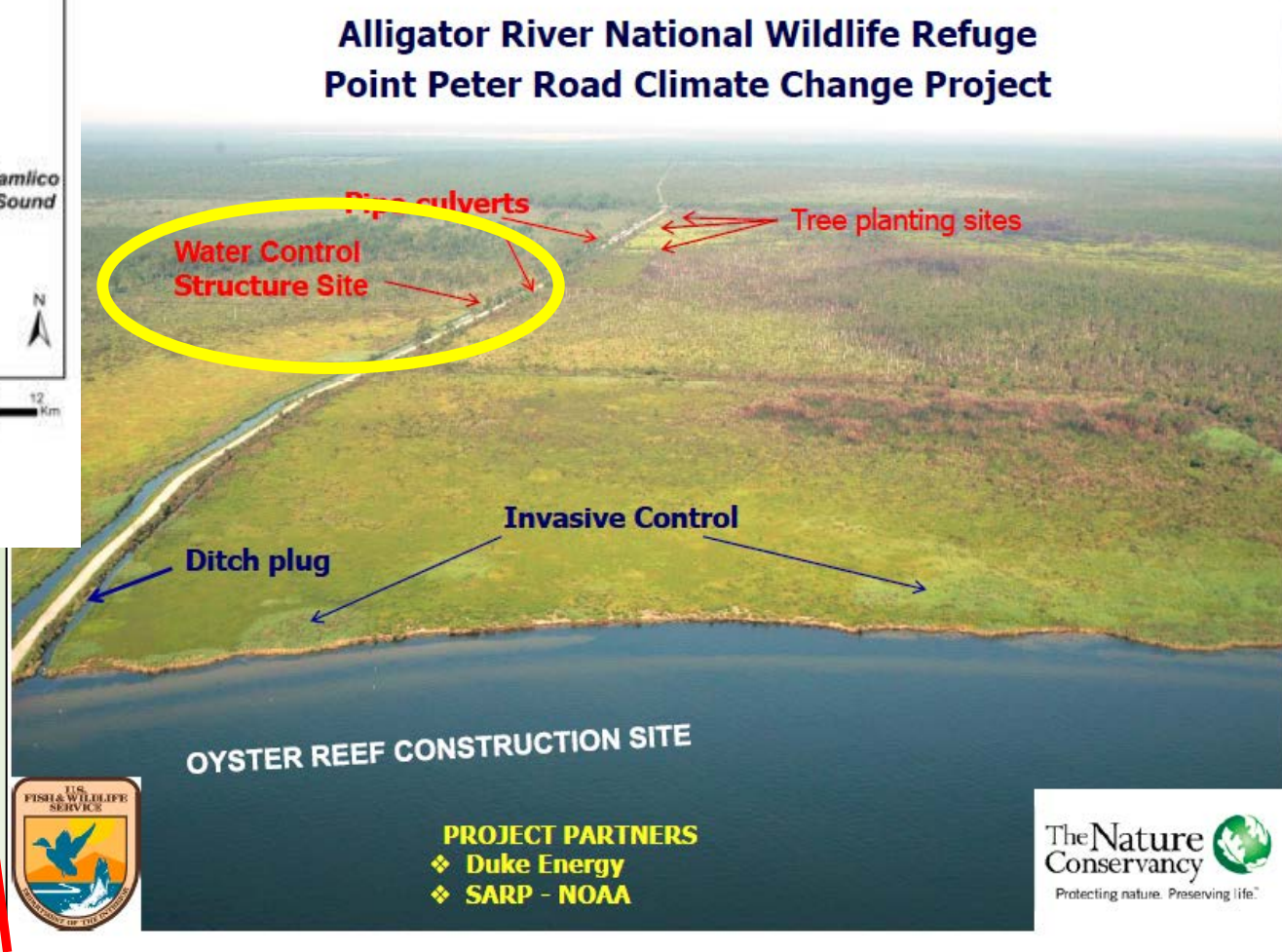
Natural Solutions
Coastal Adaption Approaches

1. **Restore hydrology**
   a) Water control structures -> prevent salt water intrusion
   b) Ditch plugs -> reduce drainage, low DO plumes
2. **Construct oyster reefs**
   a) Marl and shell bag reefs -> reduce erosion, provide habitat
3. **Vegetative plantings**
   a) Flood- and salt-tolerant species -> establish native tree species, eventually accrete biomass, provide habitat

The Nature Conservancy
Protecting nature. Preserving life.®

Point Peter Road Demonstration Site

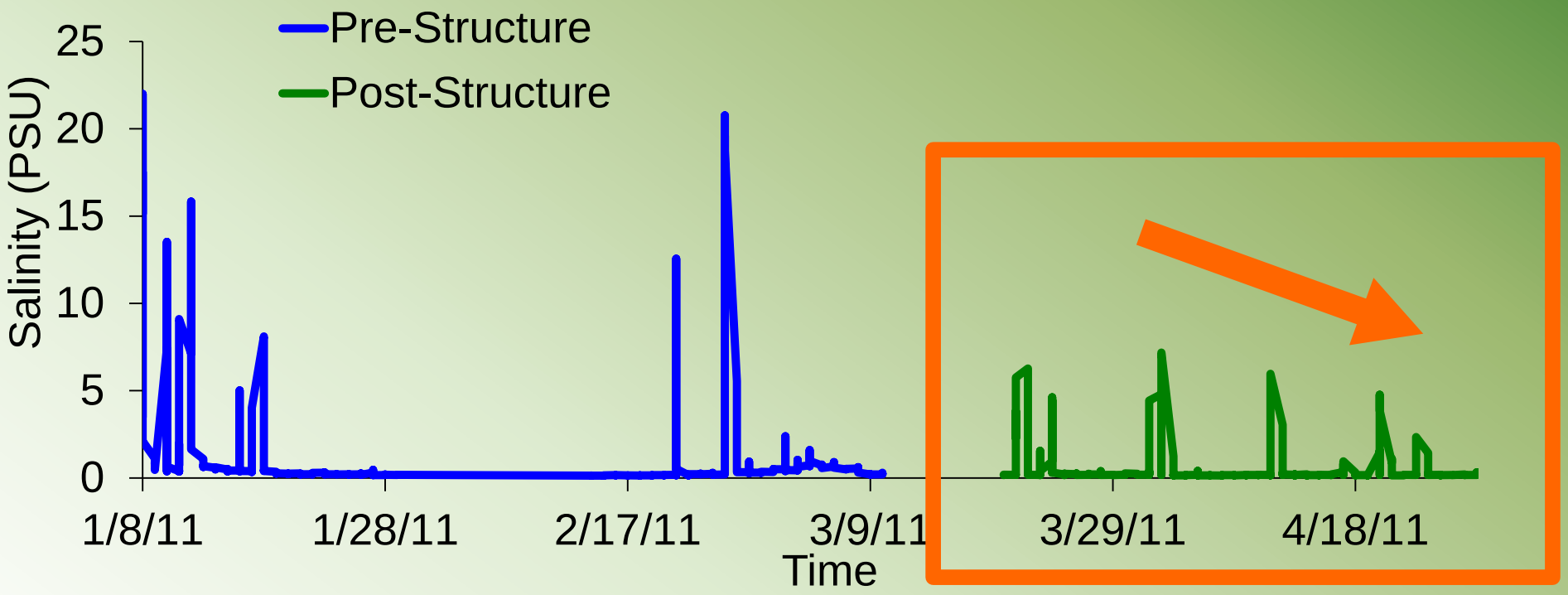




Point Peter Road Water Control Structure

The Nature Conservancy
Protecting nature. Preserving life.®

Salinity Upstream (Behind) of the Structure



The Nature Conservancy
Protecting nature. Preserving life.®

Summer of 2011: Fire & Rain

Pains Bay Fire: May-August 2011

Pumping

Average Salinity: 12 PSU (May-Aug)

Hurricane Irene: Late August 2011

Storm Surge

Average Salinity 5 PSU (Aug-Dec)

The Nature Conservancy

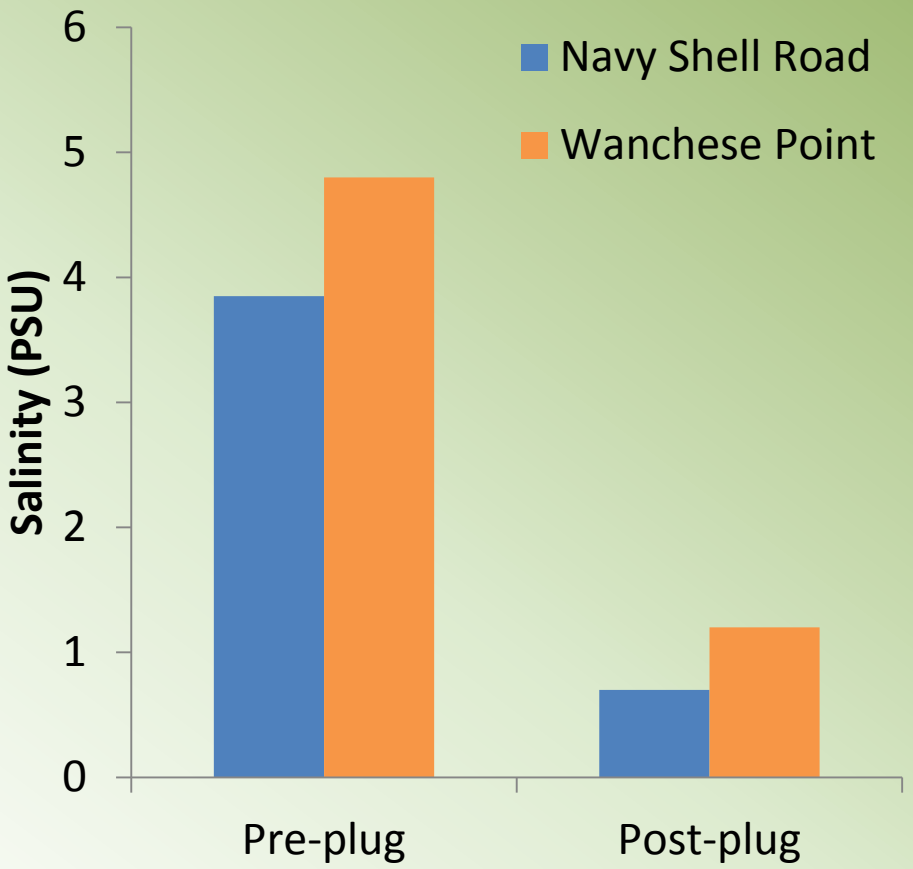
Protecting nature. Preserving life.®

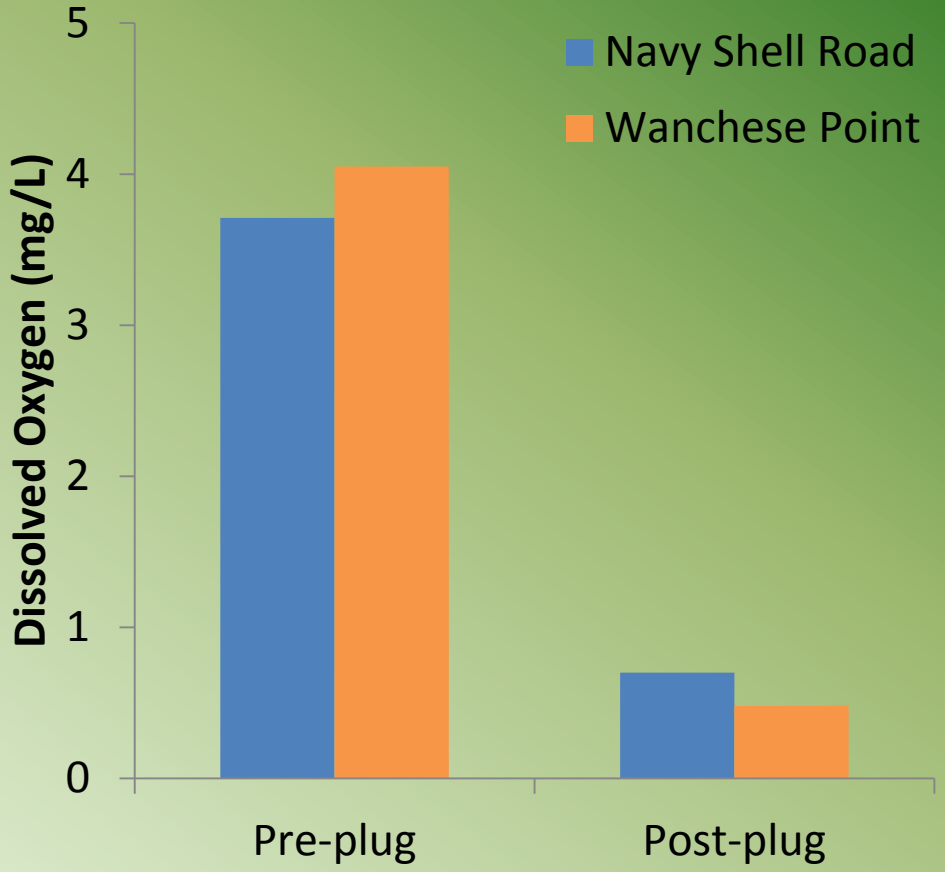
Ditch Plugs

- Address daily wind-driven water movement
- Often complement oyster reefs
- Pre- and post-installation measurements
  - Salinity
  - Dissolved oxygen
- Promote surface sheet flow

The Nature Conservancy
Protecting nature. Preserving life.®

Assessment of Ditch Plugs





The Nature Conservancy
Protecting nature. Preserving life.®

Alligator River National Wildlife Refuge
Point Peter Road Climate Change Project

U.S. FISH & WILDLIFE SERVICE

PROJECT PARTNERS

- Duke Energy
- SARP - NOAA

The Nature Conservancy
Protecting nature. Preserving life.™

Oyster Reefs

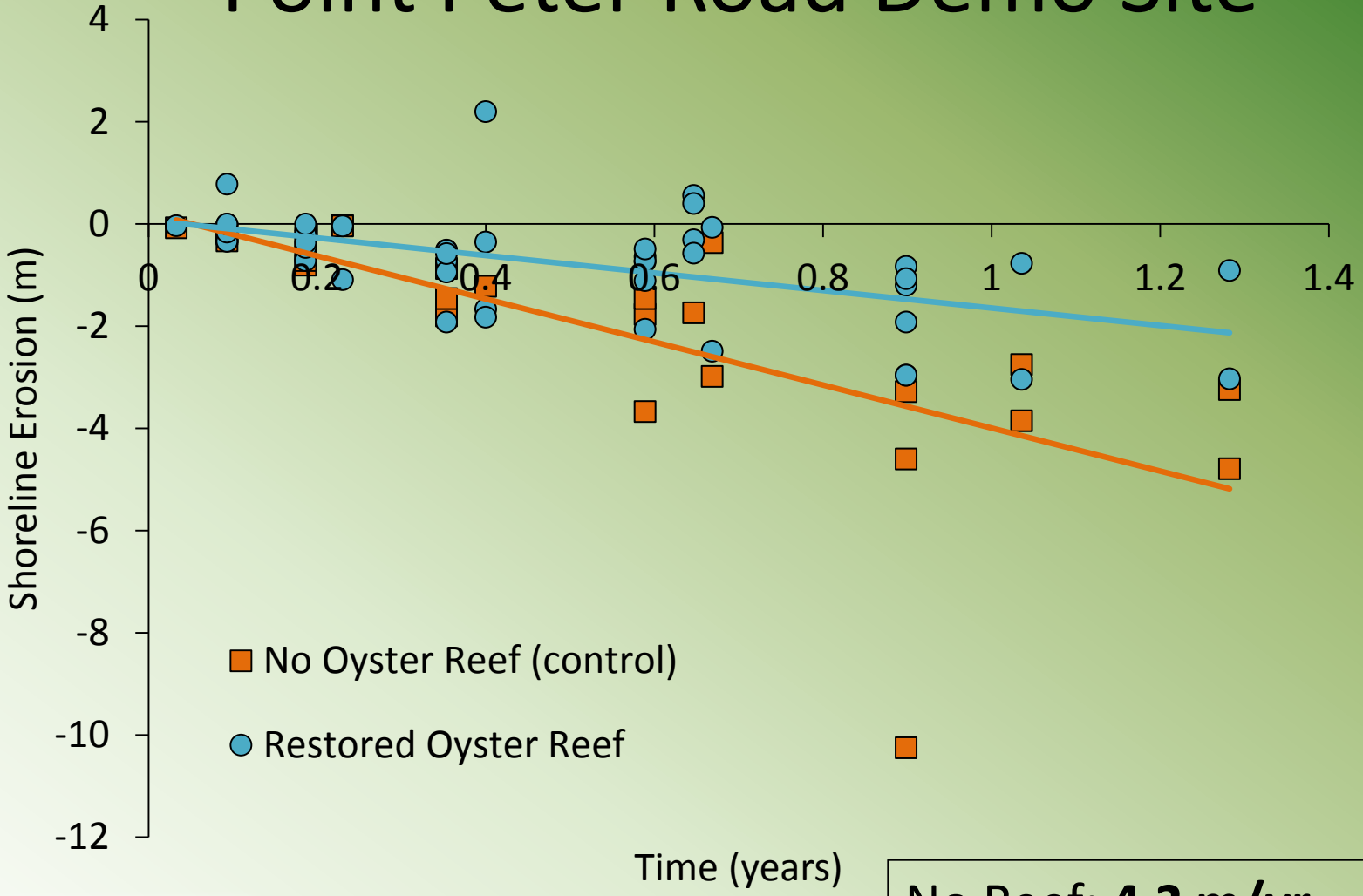
The Nature Conservancy
Protecting nature. Preserving life.®

Oyster Reef Measurements

- Shoreline erosion behind reef vs. control
- Marl vs. Shell bag
  - Oyster size
  - Oyster density
- Habitat for other organisms

The Nature Conservancy
Protecting nature. Preserving life.®

Oyster Reefs and Erosion at Point Peter Road Demo Site



No Reef: **4.2 m/yr**
Established Reef: **1.7 m/yr**

The Nature Conservancy
Protecting nature. Preserving life.®

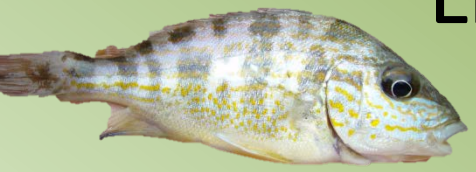
Marl vs. Shell Bag Reefs

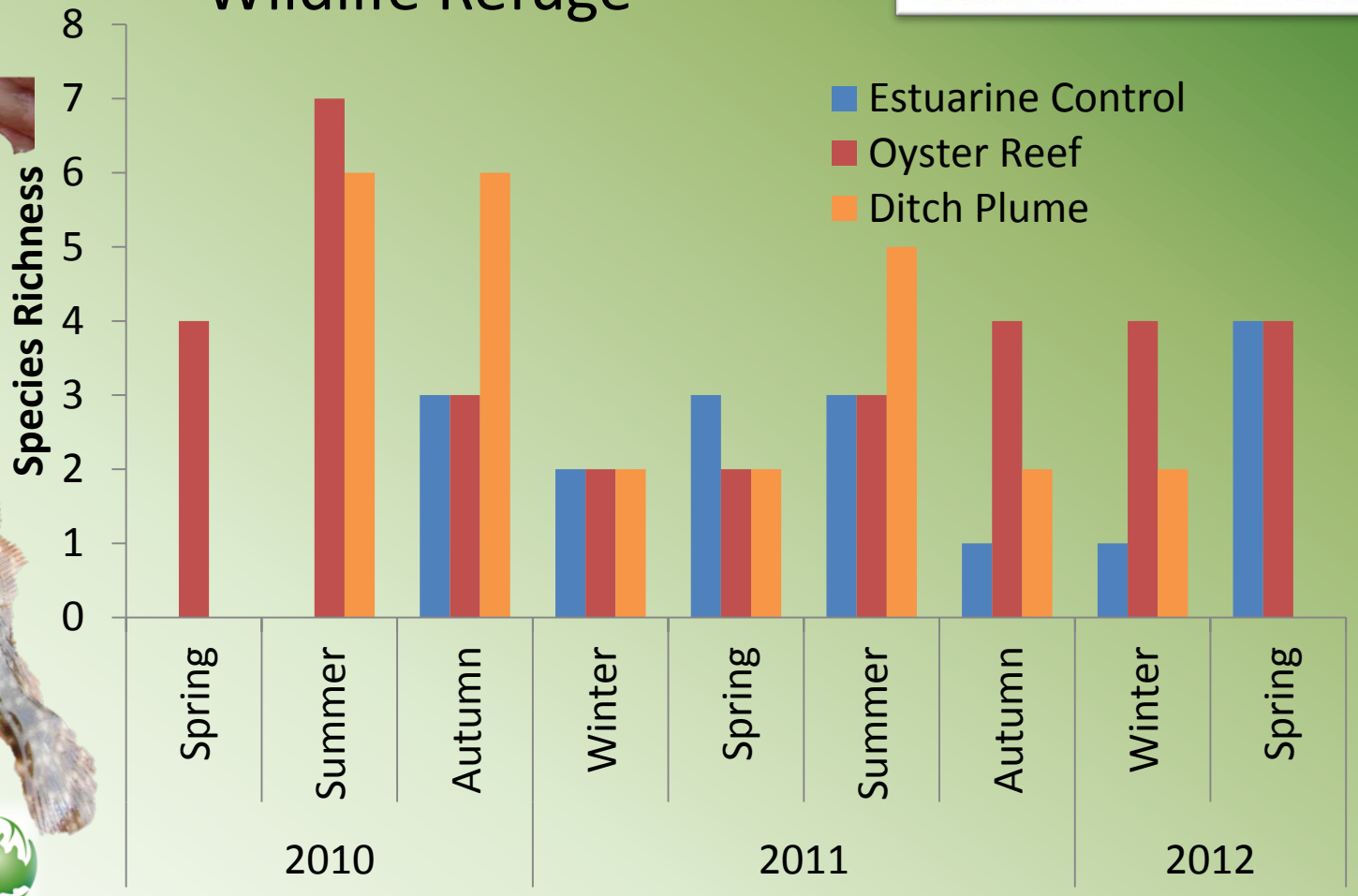
- Oyster size:
  - **Marl** > Shell bag
- Oyster density:
  - **Shell bag** > Marl
- Material Cost:
  - Marl ≈ Shell bag
- Time investment:
  - **Shell bag** > Marl

The Nature Conservancy
Protecting nature. Preserving life.®

Living Reefs at Point Peter Road!

Alligator River National Wildlife Refuge

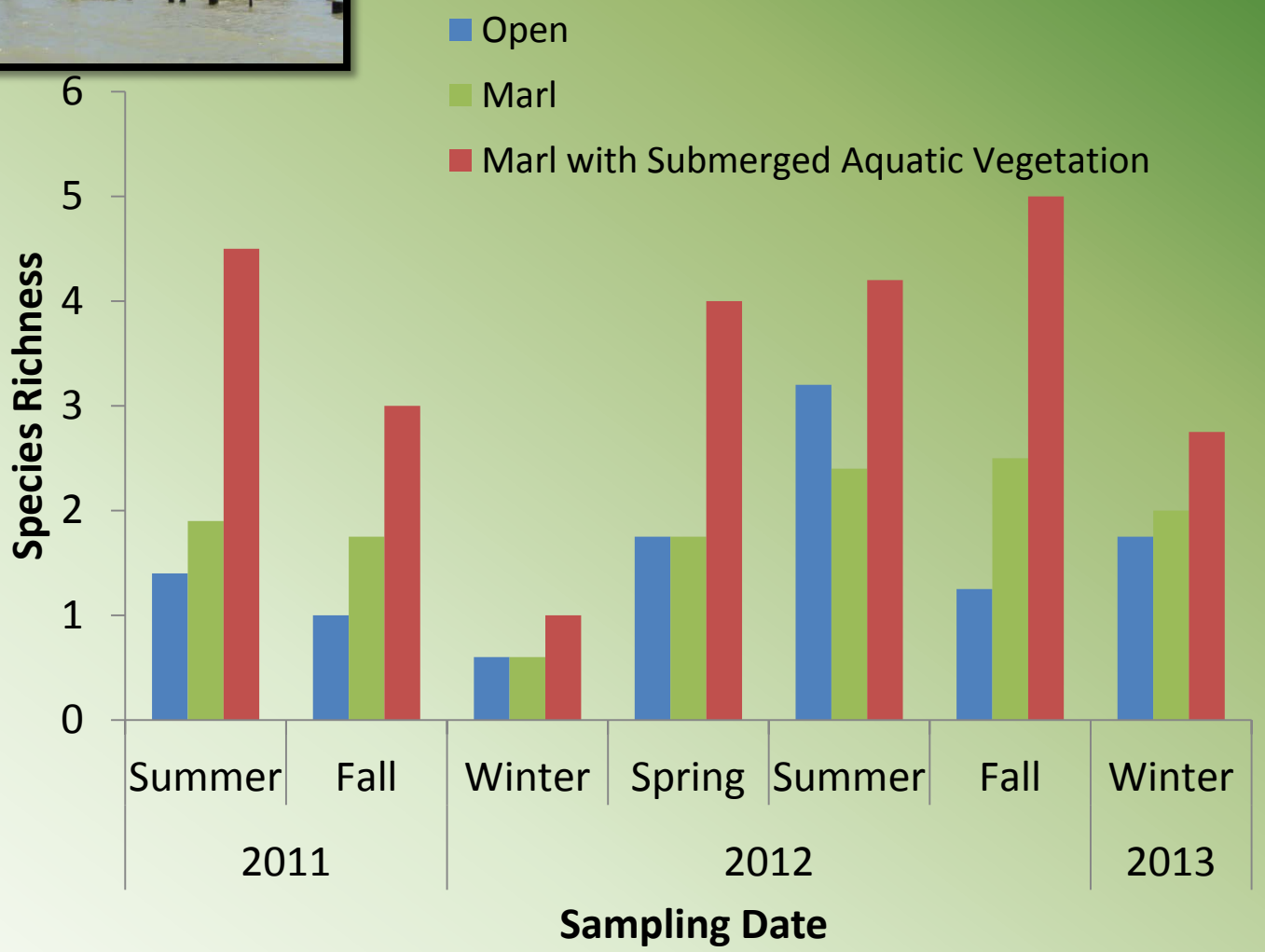




The Nature Conservancy
Protecting nature. Preserving life.®

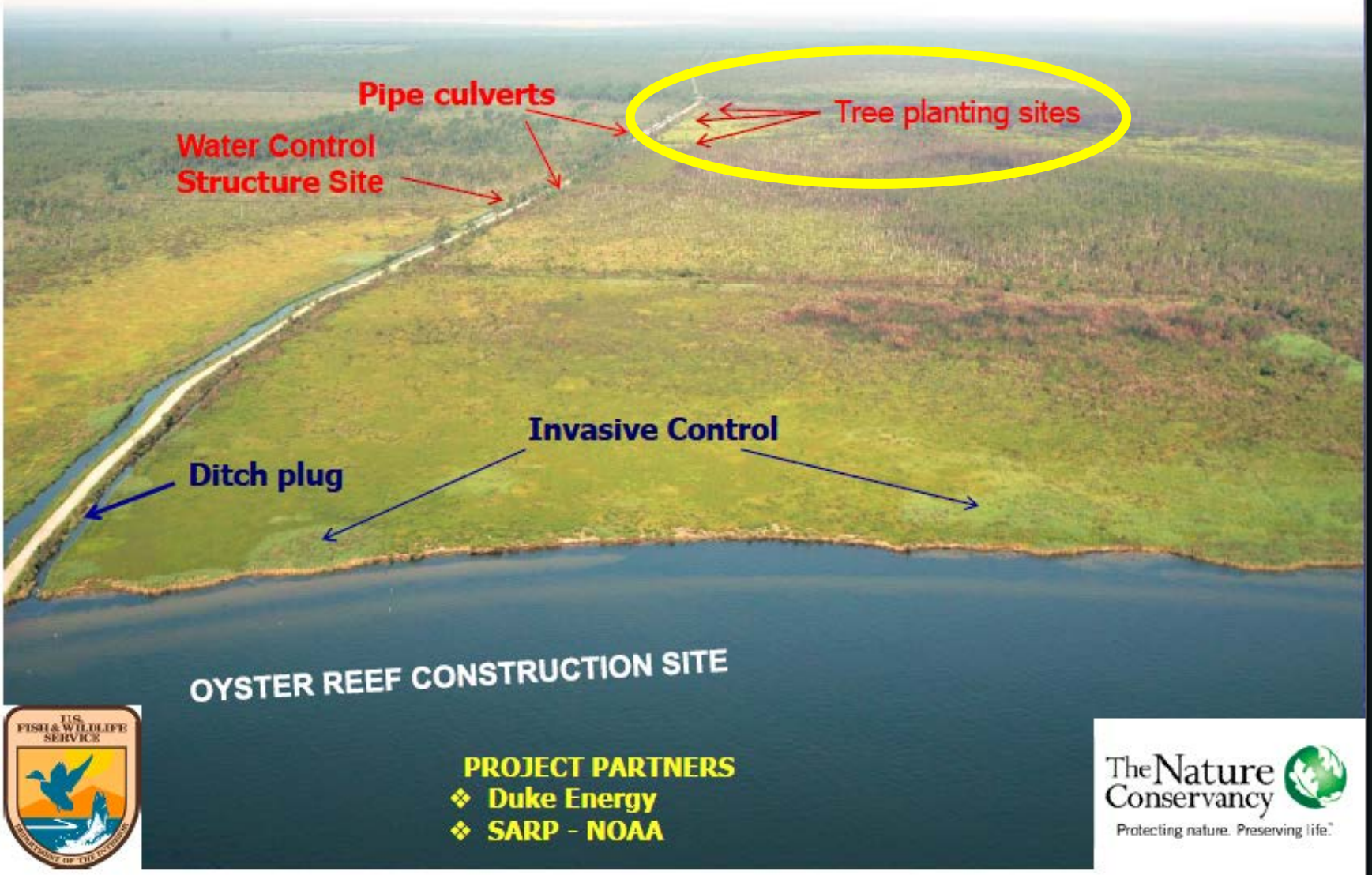
Marl at Bell Island Pier

Swanquarter National Wildlife Refuge



The Nature Conservancy
Protecting nature. Preserving life.®

Alligator River National Wildlife Refuge
Point Peter Road Climate Change Project



U.S. FISH & WILDLIFE SERVICE

PROJECT PARTNERS

- Duke Energy
- SARP - NOAA

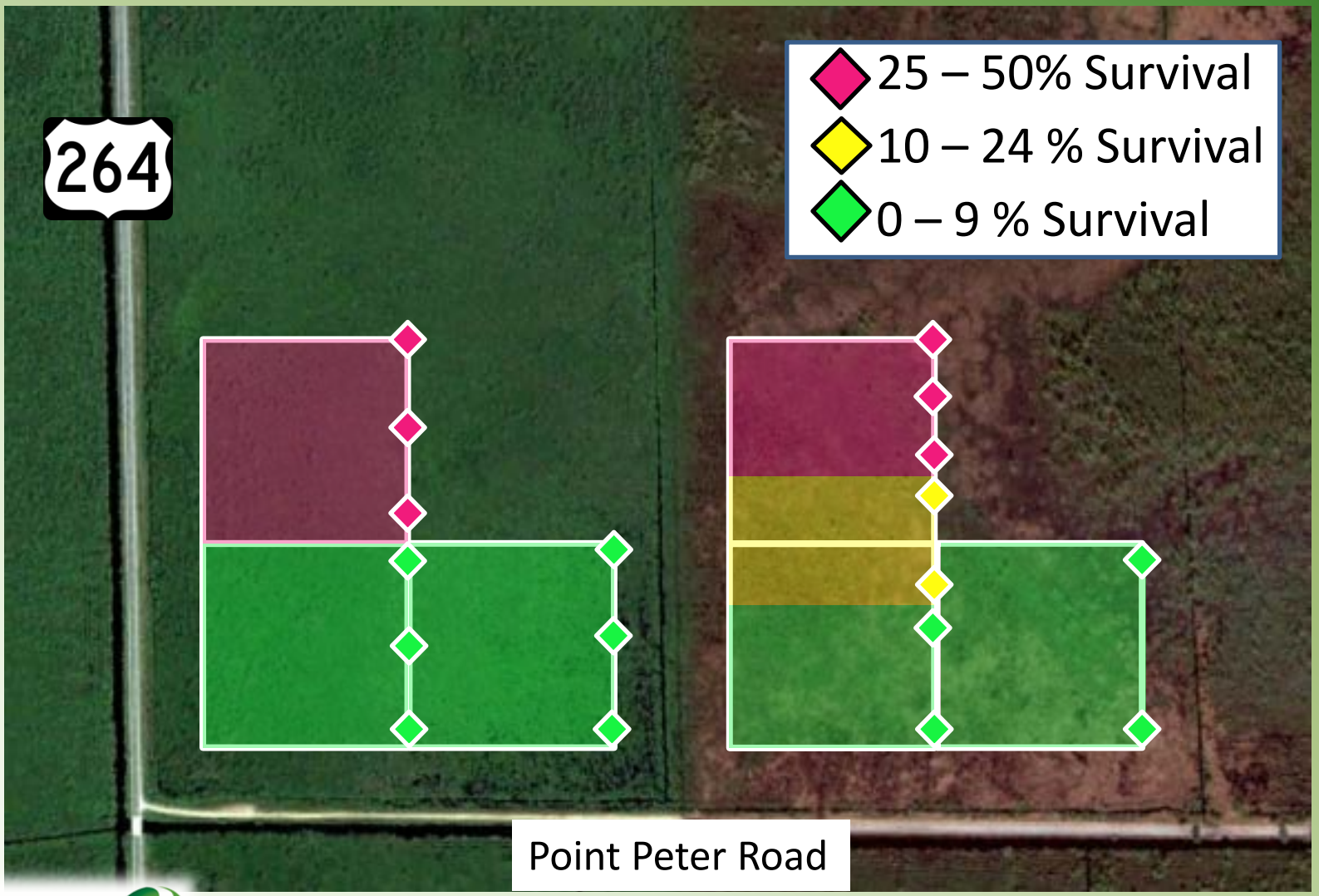
The Nature Conservancy
Protecting nature. Preserving life.™

Salt- and Flood-tolerant Vegetation

- Planting design
  - 40 acres
  - 11,500 bald cypress
    2,000 black gum
    6,750 pond pine
- Planted March 2010
- >90% transplant survival
- Hurricane Irene 2011

The Nature Conservancy
Protecting nature. Preserving life.

Bald Cypress Survival



The Nature Conservancy
Protecting nature. Preserving life.®

Lessons Learned:

1. **Restore hydrology**
   a) Water control structures
      - Preliminary data suggest that it reduces salt water intrusion
      - Withstood two major storms (Irene and Sandy)
   b) Ditch plugs
      - Data suggest that they prevent salt water intrusion, help contain low DO water
      - Difficult to access (cost), may need reinforcement
      - Natural plugs (fallen trees, *Phragmites australis*)
   c) Permits
      - Long-term process

The Nature Conservancy
Protecting nature. Preserving life.®

2. Construct oyster reefs

a) Marl and shell bag reefs

- Reduce erosion and provide habitat
- Marl for large scale, time-sensitive projects
  - Size of marl, width of reef
- Shell bag for volunteer involvement, outreach
- Consider the best design/permit for the location, resources, and scale

The Nature Conservancy
Protecting nature. Preserving life.

3. Vegetative plantings

a) Flood- and salt-tolerant species

- Plant diverse communities to address future environmental extremes
- Collect hydrology data for the area and match wetland species

Next Step:

Economic valuation of ecosystem services preserved through adaptation approaches.

The Nature Conservancy
Protecting nature. Preserving life.

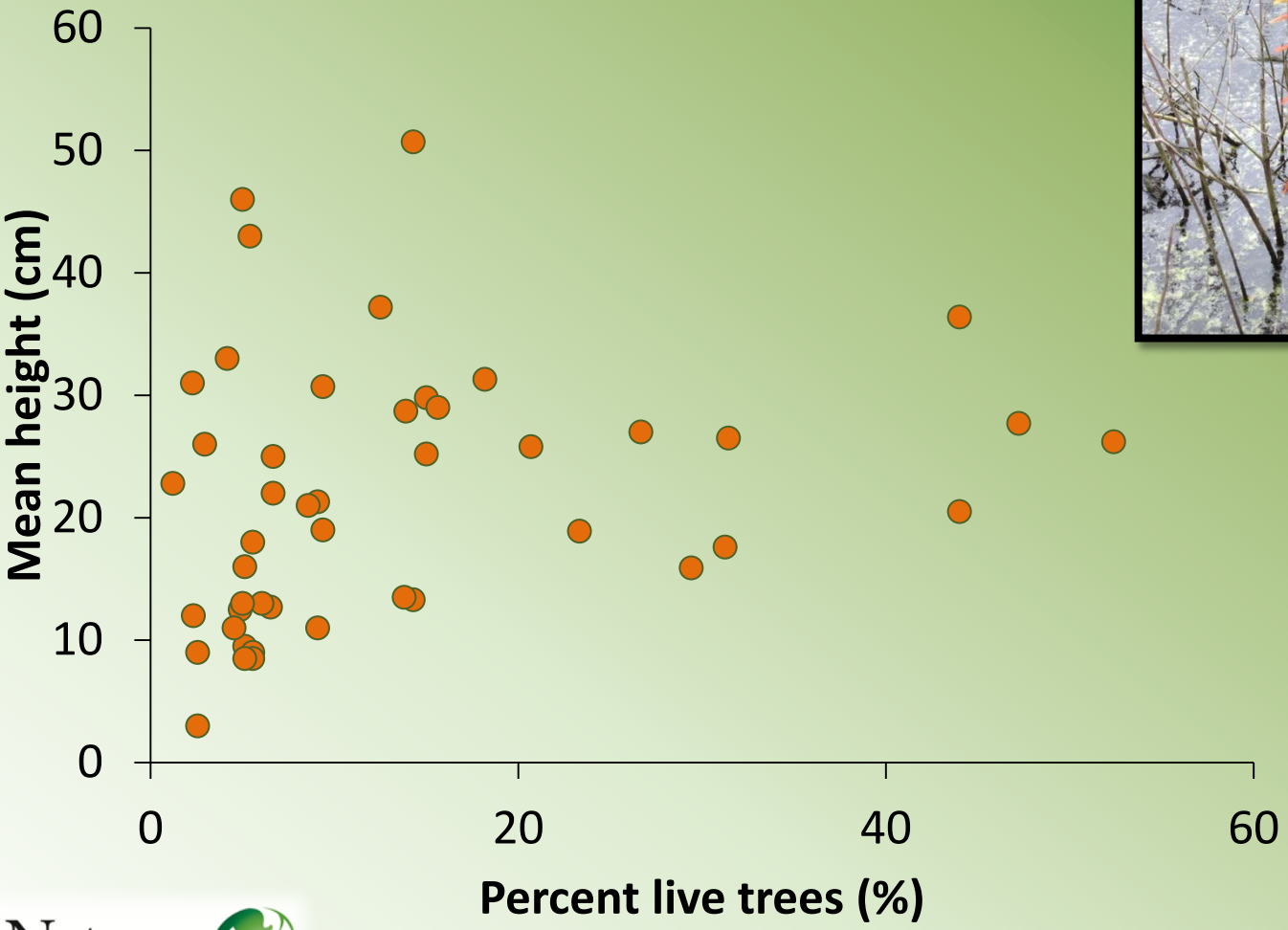
Acknowledgments

- TNC
  - Chuck Peoples
  - Aaron McCall
  - Kate Murray
  - Brian Boutin
  - Becca Benner
  - Mike Horak
- US Fish & Wildlife Service
  - Mike Bryant
  - Scott Lanier
  - Dennis Stewart
  - Brian van Druten
- Volunteers
  - Kelly and Coleman Davis

- Funding Kindly Provided By:
  - Duke Energy
  - TNC-NOAA Community-based Restoration Program
  - SARP-NOAA Community-based Restoration Program
  - FAF-NOAA Community-based Restoration Program
  - Albemarle-Pamlico National Estuary Program
  - Wildlife Conservation Society Wildlife Action Opportunities Fund
  - Grady-White Boats
  - Private donations


Questions?
cpickens@tnc.org
John Warner

Baldcypress Seedling Survival and Growth 2012



The Nature Conservancy
Protecting nature. Preserving life.®